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- 357, 504. *Solidago Canadensis*, L.  
 358, 505, 524, 544. *Solidago Curtisii*, Torr. and Gray.  
 170, 238, 422, 563. *Solidago erecta*, Pursh.  
     517. *Solidago flexicaulis*, L.  
     420. *Solidago nemoralis*, Ait.  
     109. *Solidago odora*, Ait.  
     498. *Solidago patula*, Muhl.  
     531. *Solidago rugosa*, Mill.  
 269, 583. *Verbesina alternifolia* (L.) Britton. [*Actinomeris squarrosa*,  
     Nutt.]  
 483. *Verbesina occidentalis* (L.) Walt.  
 188. *Vernonia gigantea* (Walt.) Britton. [*Vernonia altissima*,  
     Nutt.]

### The Solandi Process of Sun Printing.\*

The above title might suggest that the following article should appear, if anywhere, in some journal upon physics, or at least not in one devoted strictly to botany. However, its purpose is only to treat a subject in its relation to the study of plant life, and therefore is offered only as a contribution to botanical technique.

The process consists, briefly, in exposing the subject, necessarily somewhat translucent, to the sunlight in a printing frame in common use by photographers, with a sheet of sensitized paper back of the subject, in the same manner as a print is taken from a negative of the ordinary sort. The paper which has thus far proved the most successful has been the "American Aristotype," for the manner of using which full directions accompany the same, and will not be entered into here.

The sun print thus obtained after it has been toned becomes the negative from which the positive picture is printed. To do this quickly and to the best advantage, the negative print is placed back downward in a dish containing a thin layer of common kerosene, care being taken to wipe it free from all surface oil after being removed. This negative saturated with the kerosene is placed face inward upon a clean plate of glass in the printing

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\* The substance of this paper, with many illustrative prints, was presented before Section G., A. A. S., Madison, August, 1893.

frame and upon it a fresh sheet of the "Aristo" paper is laid and clamped in place. The printing of the positive in the full sunlight is the work of only a half minute or so, but better results are often obtained by a slower printing in diffused light; in fact the same rules hold good for this form of printing as for that of ordinary negatives taken by means of the camera.

The process of toning is the same for the positive as the negative, and in the same bath an indefinite number of either or both may be undergoing the process at the same time.

The fact that the object needs to be partially translucent places limitations upon the application of the process, as likewise does the inability to enlarge or reduce the size of the object. There are, however, very many instances when the process may be employed with a considerable degree of satisfaction, and in some cases it is possible to bring out points of structure not recorded by the ordinary methods of photography. The principle is different, for in the one reflected light is ordinarily employed and a surface picture only is obtained; but by the Solandi (Sol and I) process the picture is obtained by the unequal transmission of light through the different parts of the object. For example a leaf variegation may be confined to the surface cells and is easily caught by photography, but not in the sun print. On the other hand the variegation may be more than skin deep and the results may be reversed by the two methods. Any object that is naturally thin enough to permit the passage of light, even feebly, may become a subject for sun printing, the time of exposure being correspondingly increased. Thick leaves like the orange, through which but little light seems to pass will give good prints after an exposure of a few hours, while ordinary leaves, as those of the maple, are quickly done. The orange leaf is a case in point where the sun print reveals in a striking manner the number, size, position, etc., of the oil glands, all of which are not secured in the common photograph. Anything like the venation of leaves is of course secured with full details by the process of transmitted light. In like manner many good records can be made of the various rusts, leaf spots and blights upon foliage, and excellent pictures of wood are secured when thin sections in any direction of the grain are employed.

In the case of leaves the negative may be secured from the freshly gathered specimens without any preparation; but dry objects from the herbarium work fully as well and often better when they are first saturated with the kerosene, in the same way as for the negative sun-prints and wiped free of excess of oil before being placed in the frame.

It was my hope to show to the readers of the BULLETIN actual specimens of the work done by the Solandi process, but it may be even better to present two engravings, as they will indicate that the sun prints may be used for illustrations in printed articles with a fair degree of success. Figure 1 shows a leaf of the com-

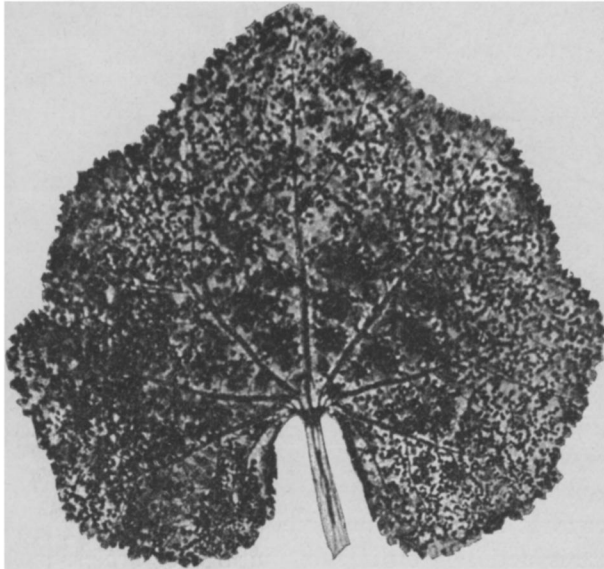


FIG. 1.—HOLLYHOCK LEAF WITH RUST (*Puccinia malvacearum*, Mont.).

mon hollyhock badly infested with the rust (*Puccinia malvacearum*, Mont.); this object being chosen as one that is a fair average as pathological specimens go, there being no marked light and dark patches as seen from a surface view. The transmitted light brings out the sori of the *Puccinia* in sufficient prominence to make them fairly distinct and much better than could have been done by ordinary photography. The second is another leaf (*Polygonatum*),

but of a widely different class from the mallow, in which the veining is prominent and the work of a leaf miner is illustrated, as also the presence of a blight (*Phyllosticta cruenta*, Fr.) following in the wake of the ruin caused by the insect and producing its fruiting pycnidia.

By this process there is no opportunity for any minifying or magnifying of the object, and each detail is as exact as to size, location, etc., as possible. But the strongest points in favor of the process, aside from the merits of the results, are the ease with which the picture may be taken by any one, and the remarkable cheapness, for no camera or dark room is needed, and the whole time for the first exposure of the object until the positive is fin-

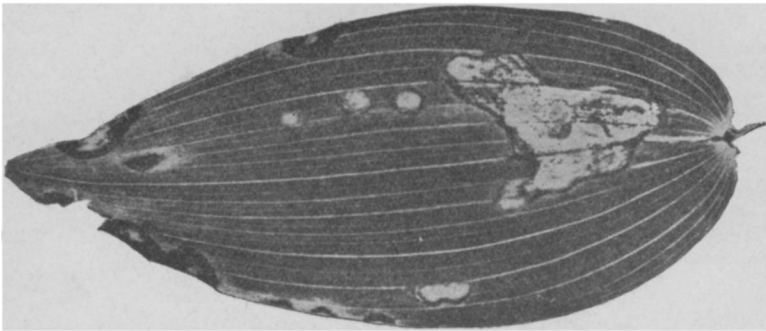


FIG. 2.—LEAF OF *Polygonatum biflorum* with Leaf-Miner, followed by *Phyllosticta cruenta*, FR.

ished may not be more than three hours.

There is nothing new in sun-printing, for Professor Kellerman and other American botanists have employed it. The chief point to be urged is the use of the clarifying agent, kerosene, for subjects when they are dry and for negative prints. This not only diminishes the time of exposure ten fold and more, but remarkably sharpens the details of the positive picture.

BYRON D. HALSTED.

RUTGERS COLLEGE, November 13, 1893.